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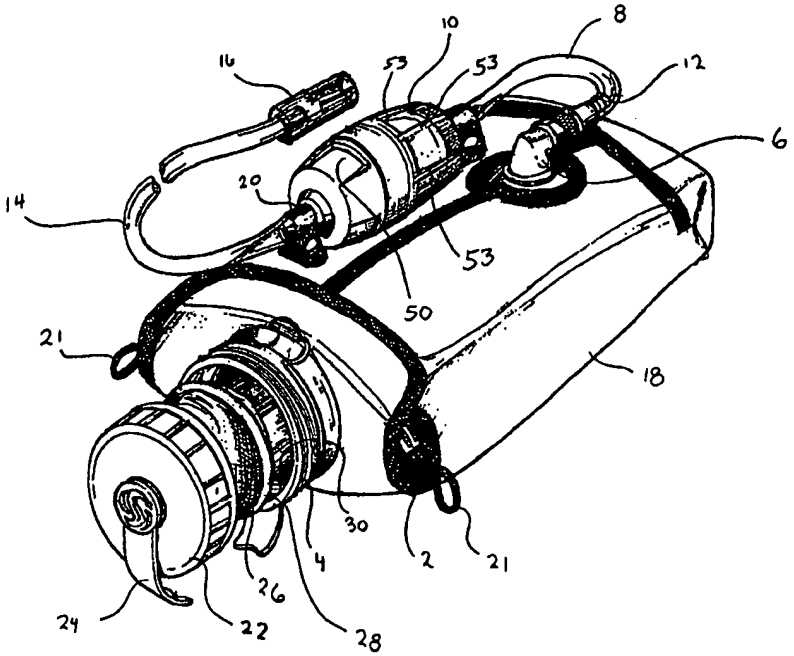

(57) Abstract

A low pressure portable water filtration system purifies water through an in–line filter that enhances filter media longevity by purifying only the volume of water used. Both a primary filter and a spring loaded positive seal pre–filter are employed. The water is held in a bladder–like container.

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PORTABLE WATER FILTRATION SYSTEM

Related Application Information

This application claims priority from U.S. provisional patent application S.N. 60/096,189, filed August 11, 1998.

Background of the Invention

This invention relates to water filtration and more particularly to an improved portable water filtration system.

Purification of water has long been a problem with outdoor sport and leisure related enthusiasts. While portable filtration systems have been developed that purify water by passing it through a filter media to ensure the removal of inorganics, organics, radiological and microbiological impurities, this media tends to be quite dense and offer a substantial resistance to flow. This necessitates a level of complexity in the filtration system that incorporates components like pressurizers, pumps, backflow check valves, balancing valves and such. Along with this extra level of complexity comes the potential for failure of these components and the resultant possibility of contamination reaching the user.

Filtration media has a limited life and is capable of only safely filtering a certain volume of water before replacement or regeneration of the media is necessitated. Filtration media is relatively expensive with the cost of replacement often surpassing the cost of the rest of the filtration system. To enhance filter media longevity, it is important to minimize the amount of impurities that reach the filter media and to filter only the volume of water that will actually be used. Much of the

prior art filters specific quantities of water regardless of the amount used.

Many of the existing portable water filtration systems have a cleanable pre-filter to capture the larger impurities thereby increasing the life of the filter media. The problem with most pre-filters is that there is often no way to ensure a proper seal of the pre-filter such that it is impossible for any of the water to bypass the pre-filter, leading to premature exhaustion of the filter media.

Another problem encountered with the existing water filtration systems is that replacement of the filter media involves mechanical steps such as replacement of o-rings or seating of check valves, that if not performed properly, can lead to water leakage and the possibility of unfiltered water bypassing the filter media.

Prior art portable water filtration systems have the filter media incorporated into the container which reduces the volume of water which can be held in the container and necessitates the incorporation of larger sized containers into the system. Since filter media commonly have an electric charge associated with them, placing the media in a water container allows an ongoing or passive purification to occur. Since this purification may be directed to water that is never used, the media is prematurely exhausted. Also, since most cartridges are not translucent, visual inspection of the condition of the seals, filters, filter media, etc. is not readily possible.

There exists the need for a less expensive and less complex filtration system that efficiently filters and purifies water while removing the possibility of transmitting contaminated water on to the user.

Summary of the Invention

In accordance with the invention, an improved portable water filtration system is provided wherein the filter media is located in-line with a tube that dispenses water from a collapsible bladder source. Typically only the volume of water actually being consumed at a particular moment is purified on demand.

Accordingly, it is an object of the present invention to provide an improved portable water filtration system that eliminates virtually all possibility of allowing impure water to reach the consumer

It is another object of the present invention to provide an improved water filtration system with an enhanced filter sealing system.

It is a further object of the present invention to provide an improved portable water filtration system that offers low resistance to filtration.

It is yet another object of the present invention to provide an improved portable water filtration system that uses a minimum of parts and sealing elements, thereby reducing the probability of system component failure.

It is still a further object of the present invention to provide an improved portable water filtration system that ensures the longest possible life of the replaceable filter media.

It is still another object of the present invention to provide an improved portable water filtration system that allows for a quick and easy visual component inspection and for a simple replacement of the filter media.

It is another object of the present invention to provide an improved portable water filtration system that incorporates a pre-filter that has a positive

sealing system to eliminate any unfiltered water from reaching the filter media.

The subject matter of the present invention is particularly pointed out and distinctly claimed in the concluding portion of this specification. However, both the organization and method of operation, together with further advantages and objects thereof, may best be understood by reference to the following description taken in connection with accompanying drawings wherein like reference characters refer to like elements.

Brief Description of the Drawings

FIG. 1 is a perspective view of the water filtration system according to the present invention;

FIG. 2 is a perspective view of a filter cartridge housing according to the present invention;

FIG. 3 is a is a perspective view of a filter cartridge;

FIG. 4 is a cross sectional view of the preferred embodiment of the filter cartridge;

FIG. 5 is a cross sectional view of an alternate embodiment of the filter cartridge; and

FIG. 6 is a cross sectional view of another embodiment of the filter cartridge with a different style pre-filter.

Detailed Description

Referring to FIG. 1, a perspective view of the water filtration system according to the preferred embodiment, the general assembly of the components can be seen. The system has a flexibly resilient collapsible bladder 2 connected to a flexible delivery tube that has a filter cartridge 10 residing in-line. Collapsible bladder 2 is fabricated from a flexibly resilient thin walled polymer, having sealable filler

neck 4 and bladder fitting 6 located at distal ends. Bladder 2 is connected to a dispensing tip 16 by two sections 8, 14 of a flexible delivery tubing which accommodate the in-line connection of filter cartridge 10. Opposite ends of flexible filter tube 8 are secured onto a barbed fitting of bladder 6 and a barbed fitting of filter cartridge 10, while one end of delivery tube 14 is secured onto the barbed fitting of filter cartridge 10 and the opposite end of tube 14 is connected to dispensing tip 16.

A cover 18 releasably houses collapsible bladder 2 therewithin and is adapted to secure filter cartridge 10 onto the exterior surface of the cover 18 by use of releasable retention straps 20. Cover 18 also accommodates the attachment of carrying straps (not shown) onto loops 21 which are suitably mounted to left and right edges of the cover at the end nearest the filler neck.

Filler neck 4 is suitably a cylindrically shaped opening into the interior of the bladder, and has threads formed on the exterior thereof. A threaded cap 22 is suitably configured to engage the threads of the filler neck to form a watertight seal. Cap 22 is prevented from accidentally being lost by connection to filler neck 4 via tether 24. A removable primary filter 26 is provided comprising of a screen filter securely affixed to a flexible O-ring 28, which is suitably sized to engage a circumferential groove 30 formed in the interior wall of filler neck 4. Groove 30 is spaced away somewhat from the end of the filler neck that is most distal from the bladder.

Referring to FIG. 2, a perspective view of a filter cartridge housing, filter cartridge housing 32 comprises two cylindrical dome-shaped housing halves, outlet housing 34 and inlet housing 36, and an O-ring

38. The housings are constructed out of a plastic or suitable polymer, and O-ring 38 is fabricated from a rubber or polymer with suitable flexibility characteristics. In the preferred embodiment inlet housing 36 is translucent to allow visual inspection of the filter cartridge components. Inlet housing 36 has a wide, open end and a narrow, more closed end, and is threaded with threads 40 on the internal wall of the open end thereof. A circumferential land surface 42 is formed adjacent to the innermost thread so as to act as a seat for O-ring 38 to fit against. Outlet housing 34 is correspondingly shaped, and is threaded on the external wall of its open end, for engagement with the threads of the inlet housing. When the two housing halves are threaded together, O-ring 38 compresses between land surface 42 and the leading edge of outlet housing 34, thereby forming a watertight seal.

Outlet housing 34 has an outlet barb fitting 44 formed centrally of dome section 43 opposite the open end of the house, parallel to the longitudinal axis of the housing. Barb fitting 44 has a longitudinal outlet orifice 46 therethrough. Inlet housing 36 has corresponding inlet barb fitting 48 with inlet orifice 49 (FIG. 4) located centrally thereon on dome portion 45 opposite the open end of the housing. Outlet housing 34 has plural depressions 50 equally spaced circumferentially thereon, while inlet housing 36 carries plural longitudinal ribs 53 (see FIG. 1) spaced equally about the periphery of the housing, to enable a user to easily grasp the filter for disassembling the housing. In the preferred embodiment, there are four depressions 50 and six ribs 53. For clarity of illustration, ribs 53 are not shown in FIGs. 2 and 3. Although in the illustrated embodiment, the inlet and outlet fittings are barbed, in alternate embodiments

they may be of any configuration adaptable to the attachment of flexible tubing.

Referring now to FIG. 3 and FIG. 4, which are a perspective view and a cross sectional view of the preferred embodiment of the filter cartridge, the assembled filter cartridge 10 includes a filter media cone 52 and pre-filter 51 therewithin. The filter media cone is formed as an open ended bell-shaped configuration. Filter media cone 52 is frictionally engaged in outlet housing 34 between adhesion ring 60 formed inside the closed end of the housing and the inner surface of outlet housing 34, and is secured in this position by a suitable non-porous waterproof adhesive that resides at least in cavity 62 and bonds and seals all areas of contact between filter media cone 52, adhesion ring 60, and the inner surface of outlet housing 34. This manner of securement eliminates the possibility of any impure water bypassing filter media cone 52 and reaching the dispensing tip in an impure state.

Pre-filter 51 is a substantially circular, dish-shaped 25 micron stainless steel screen 54 that has its peripheral edge molded into a sealing gasket 56. Sealing gasket 56 is fabricated from a suitably flexible polymer. The approximate central region of screen 54 has a secondary dish-shaped depression 58. When the filter cartridge 32 is assembled, pre-filter 51 is positioned in filter cartridge such that the external edge of sealing gasket 56 contacts the inner surface of inlet housing 36 thereby forming a watertight seal. As will be understood by reference to the figures, the effect of the two dished depressions is to impart a spring-like or resilient property to screen 54.

When the filter is fully assembled, the tolerances of the components that make up filter cartridge 32 are

such that filter media cone 52 contacts secondary dish-shaped depression 58 on the concave up face thereof, compressing screen 54 and exerting a force on sealing gasket 56 which ensures a continuous seal between inlet housing 36 and pre-filter 51. This design prevents the possibility of any water reaching filter media cone 52 without first passing through pre-filter 51. In the preferred embodiment, this seal is made at corner edge 64 of sealing gasket 56; however, in an alternate embodiment (FIG. 5), inlet housing 36 has internal ring profile 68 that corresponds to side profile 66 of sealing gasket 56 so that the seal is made along side profile 66 of gasket 56.

Because of the resilient property of screen 54, and the close tolerances of the components in filter cartridge 10, the seal made by gasket 56 is "preloaded" by the downward force exerted on screen 54 by filter media cone 52 thereby maintaining seal continuity. This seal, as well as the condition of the filter media, can be visually confirmed at any time through the translucent body of inlet housing 36.

Again referring to FIG. 1 and FIG. 4, the operation and features of the portable water filtration and purification system can best be described. In use, impure water is added into bladder 2 through filler neck 4 with cap 22 removed. The impure water passes through the screen of primary filter 26 which removes any gross impurities. If primary filter 26 clogs, it may be easily removed and backwashed or scrubbed. Removal of primary filter 26 for cleaning is accomplished by pulling on the flexible screen to deform O-ring 28 until it is no longer frictionally held in place in circumferential groove 30. (Installation or replacement of primary filter 26 after cleaning follows the reverse procedure.)

Once bladder 2 is filled to the desired amount, cap 22 is threadably engaged onto filler neck 4 thereby sealing filler neck 4 watertight. The purification process is initiated by drawing a partial vacuum at dispensing tip 16, by manually pressurizing bladder 2 by squeezing, or through a combination of these two methods. Since bladder 2 is watertight, its flexibly resilient thin walls collapse as water is urged from it, thereby ensuring the system has an "on demand" delivery since there are no forces urging the flow of water unless initiated by the user. This type of system requires no backflow valves and only water which is to be used is purified. In operation, since this system purifies only the volume of water being used on demand, the life of the filter media is thereby prolonged. Additionally, the system will function regardless of the spatial orientation of bladder 2.

Impure water exits bladder 2 through bladder fitting 6 and travels down filter tube 8, entering filter cartridge 10 through inlet orifice 49 of inlet barb fitting 48 where the water traverses pre-filter 51. Once the water has moved through pre-filter 51, it passes through filter media cone 52, is filtered and travels down delivery tube 14 to dispensing tip 16.

Filter media cone 52 has a bell like configuration, with a substantially hollow interior formed therewithin, so as to maximize the filtration surface area available for the impure water to pass through. This reduces the pressure required to urge the flow of water through the system. In the preferred embodiment, the purification of water from bladder 2 can be initiated solely by suction applied from the human mouth on dispensing tip 16.

Note, since filter media cone 52 is arranged in-line, and because the flow of water is "on demand"

only, the filter media contacts a relatively small volume of water when no water is flowing, providing an advantage over filter media disposed inside water containers, because most filter media are electrically charged and have a limited number of absorption or adsorption sites thereon. A typical media constituent is an activated carbon, for example. These media continue to passively filter any volume of water that the media is placed within, thus prematurely and unnecessarily exhausting the filter media. The design of the filter cartridge of the present invention and its in-line placement minimizes this problem.

It is important that no water be allowed to exit filter cartridge 10 without passing through filter media cone 52. This might happen if there were a path whereby the water bypasses filter media cone 52 or if there is a perforation or break in filter media cone 52. However, since inlet housing 36 is clear a perforation or break can be detected and avoided by visible inspection. Further, a bypass of filter media cone 52 can only occur at the point where the cone is secured in outlet housing 34, and such bypass is prevented by the double adhesive seal between filter media cone 52 and the inner surface of outlet housing 34 and between filter media cone 52 and adhesion ring 60.

An alternative construction of the filter is illustrated in FIG. 6. The basic construction corresponds to the previously described embodiments. However, the pre-filter in this embodiment is of different construction. Referring to FIG. 6, the pre-filter comprises a disk, wafer or plug member 70 that is of substantially sufficient diameter and thickness to be wedged between the filter media 52 and the interior profile 68. The pre-filter 70 is suitably

made of a spun polypropylene, a paper media, a polyester or the like. It is also suitably made of a woven metal or other synthetic. Suitably, the pre-filter has openings therein in the range of 40 to 1 microns, with an average of about 19 microns.

While in the embodiment of FIG. 6, the pre-filter 70 is relatively thick, the thickness will vary depending on the substance from which the pre-filter is made. Such variations in thickness are accommodated by moving the profile 68 either closer or farther away from the filter media 52, so that the disk 70 is secured between the filter media and the profile 68 when the filter body halves are assembled. Alternatively, a spacer member may be positioned either between the profile 68 and the disk 70 or between the disk 70 and the filter media 52, to ensure a consistent seal and placement of the pre-filter.

Accordingly, an improved filter system is provided. The system also incorporates safeguards to ensure that no impure water reaches dispensing tip 16 and is delivered to the user, while the pressure required to operate this system is low enough that purification can be activated solely by suction applied by the human mouth. In the preferred embodiment, filter media cartridge 10 is capable of purifying a minimum of 750 liters of water from any freshwater source, removing substantially all inorganics, organics, radiological chemicals and microbiological impurities therein. The filter will remove Giardia, Cryptosporidium, E.Coli, household cleaning compounds, industrial and agricultural wastes, herbicides, pesticides and insecticides from the water, as well as a number of trace metals and turbidity. Over 99% of bacteria and protozoa are removed. If viruses are a concern, after filling the water container with

unfiltered water, a disinfectant such as iodine may be added to the water. The filter media will remove the odor, color and taste of the disinfectant from the water, resulting in a pleasant tasting water even though iodine or the like had been added to treat for the possible presence of viruses.

While plural embodiments of the present invention have been shown and described, it will be apparent to those skilled in the art that many changes and modifications may be made without departing from the invention in its broader aspects. The appended claims are therefore intended to cover all such changes and modifications as fall within the true spirit and scope of the invention.

Claims

I claim:

1. A portable water purification system comprising:

a collapsible bladder adapted to holding a quantity of water; and

a flexible flow passage having a filter cartridge situated therein, wherein said collapsible bladder and said flexible flow passage are connected such that water urged from said bladder flows through said flow passage and is purified through said filter cartridge.

2. The portable water purification system of claim 1 wherein said water is urged from said bladder by a pressure generated by manual compression of said bladder, or from a partial vacuum created by a human mouth in said delivery tube, or by a combination thereof.

3. The portable water purification system of claim 1 wherein said bladder has an upper end and a lower end, further comprising:

a cylindrical filler neck situated at said upper end of bladder with said filler neck having an inside and outside surface thereon wherein said filler neck has a circumferential groove on said inside surface;

a bladder fitting situated at said lower end of bladder adapted to connect said bladder to said flexible flow passage for the transmission of said water;

a removable primary filter further comprising a flexible screen affixed to a flexible O-ring;

a detachable cap means adapted to seal said filler neck watertight; and

a bladder cover adapted to envelop and insulate said bladder,

wherein said O-ring of the primary filter seats into said detent of the filler neck so as to position said primary filter in the stream of water filling said bladder thereby filtering said water.

4. The portable water purification system of claim 1 wherein said filter cartridge further comprises:

a bell-shaped inlet housing having an open end and a domed end, said open end having a first set of threads formed thereon, and said domed end having a first fitting with an orifice therethrough, with said first fitting adapted for connection to said flexible delivery tube, and wherein said inlet housing has a circumferential groove situated adjacent to the first set of threads and adapted to hold an O-ring;

a bell-shaped outlet housing having an open end and a domed end, said open end having a second set of threads formed thereon that matingly correspond to said first set of threads, and said domed end having a second fitting with an orifice therethrough, with said second fitting adapted for connection to said flexible delivery tube, and wherein said domed end has a raised profile ring located on an inner surface thereof and substantially centered about said second fitting;

a flexible O-ring adapted to compress to seal said filter cartridge watertight;

a filter media cone adapted to be secured between said raised profile ring and said inner surface of said outlet housing; and

a pre-filter comprising a circular screen with a circular edge that is embedded into a circular flexible gasket conforming to the profile of an inner surface of said inlet housing,

wherein said filter media cone is secured in said outlet housing and said pre-filter is located in said inlet housing and upon threaded engagement between said outlet housing and said inlet housing, said O-ring situated in said circumferential groove of inlet housing compresses to form a watertight seal, and said filter media cone contacts said pre-filter screen forcing said gasket of pre-filter into contact with said inner surface of the inlet housing thereby forming a seal.

5. The portable water purification system of claim 4 wherein said inlet housing is fabricated from a translucent plastic or polymer suitable to allow visual inspection.

6. The portable water purification system of claim 4 wherein said pre-filter screen is fabricated from stainless steel with 25 micron screen openings.

7. The portable water purification system of claim 6 where said pre-filter screen has a substantially centered first depression formed thereon and a substantially centered second depression formed thereon said first depression so as to impart a resilience to said pre-filter, wherein said resilience ensures a continuous seal between said gasket of pre-filter said inner surface of the inlet housing.

8. The portable water purification system of claim 4 wherein said filter media cone is secured

between said raised profile ring and said inner surface of the outlet housing by a suitable watertight adhesive means that prevents water from bypassing said filter media cone.

9. A portable water purification system comprising:

a collapsible bladder;

a flexible flow passage; and

a filter cartridge,

wherein said bladder is connected to said flexible flow passage having said filter cartridge situated therein, such that water is urged from said bladder by a pressure generated by manual compression of said bladder, or from a partial vacuum created by a human mouth in said delivery tube, or by a combination thereof, and flows through said flow passage and said filter cartridge and is purified, wherein said collapsible bladder further comprises:

an upper end and a lower end;

a cylindrical filler neck situated at said upper end of bladder with said filler neck having an inside and outside surface thereon wherein said filler neck has a circumferential detent on said inside surface;

a bladder fitting situated at said lower end of bladder adapted to connect said bladder to said flexible flow passage;

a removable primary filter constructed of a flexible screen affixed to a flexible O-ring;

a detachable cap means adapted to seal said filler neck watertight; and

an insulating bladder cover,

wherein said O-ring of the primary filter seats into said detent of the filler neck so as to position said

primary filter in a stream of water filling said bladder thereby filtering said water, and wherein said filter cartridge further comprises:

a bell-shaped inlet housing having an open end and a domed end, said open end having a first set of threads formed thereon, and said domed end having a first fitting with an orifice therethrough, with said first fitting adapted for connection to said flexible delivery tube, and wherein said inlet housing has a circumferential groove situated adjacent to the first set of threads and adapted to hold an O-ring and said inlet housing is fabricated from a translucent plastic or polymer suitable to allow visual inspection;

a bell-shaped outlet housing having an open end and a domed end, said open end having a second set of threads formed thereon that matingly correspond to said first set of threads, and said domed end having a second fitting with an orifice therethrough, with said second fitting adapted for connection to said flexible delivery tube, and wherein said domed end has a raised profile ring located on an inner surface thereof and substantially centered about said second fitting;

a flexible O-ring adapted to compress to seal said filter cartridge watertight;

a filter media cone secured between said raised profile ring and said inner surface of the outlet housing by a suitable watertight adhesive means that prevents water from bypassing said filter media cone; and

a pre-filter comprising a circular screen fabricated from stainless steel with 25 micron size screen openings wherein said screen has a circular edge that is embedded into a circular flexible gasket conforming to the profile of an inner surface of said

inlet housing and where said pre-filter screen has a substantially centered first depression formed thereon and a substantially centered second depression formed thereon said first depression so as to impart a resilience to said pre-filter,

wherein said filter media cone is secured in said outlet housing and said pre-filter is located in said inlet housing and upon threaded engagement between said outlet housing and said inlet housing, said O-ring situated in said circumferential groove of inlet housing compresses to form a watertight seal, and said filter media cone contacts said second depression of the pre-filter screen forcing said gasket of pre-filter into contact with said inner surface of the inlet housing thereby forming and ensuring a continuous seal.

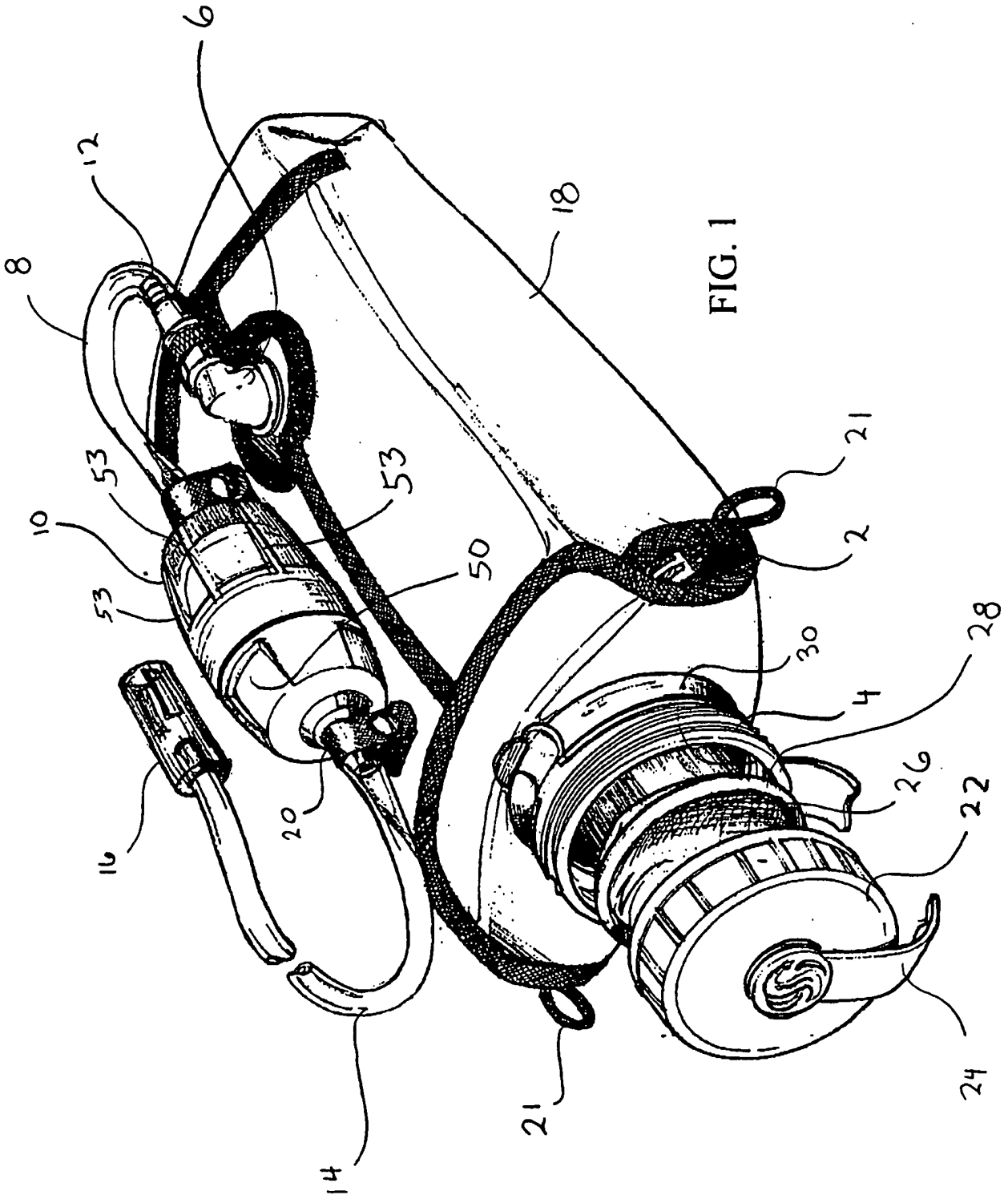

FIG. 1

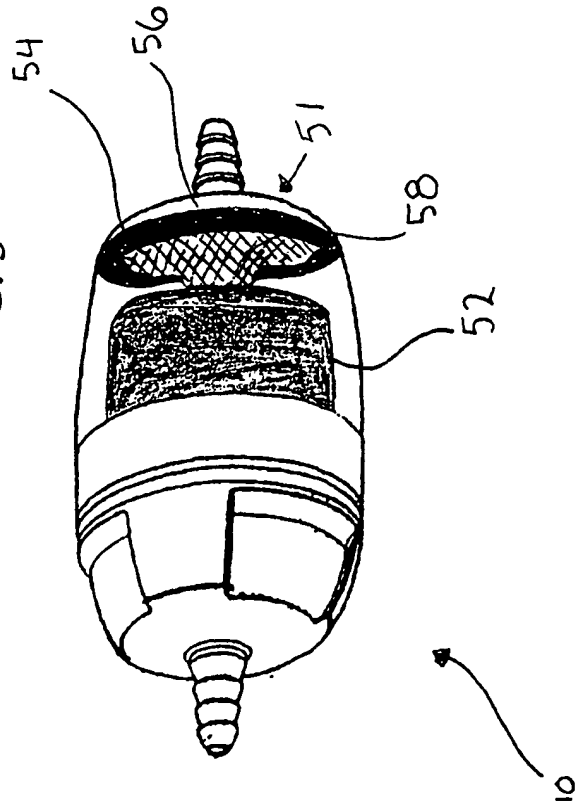

FIG. 3

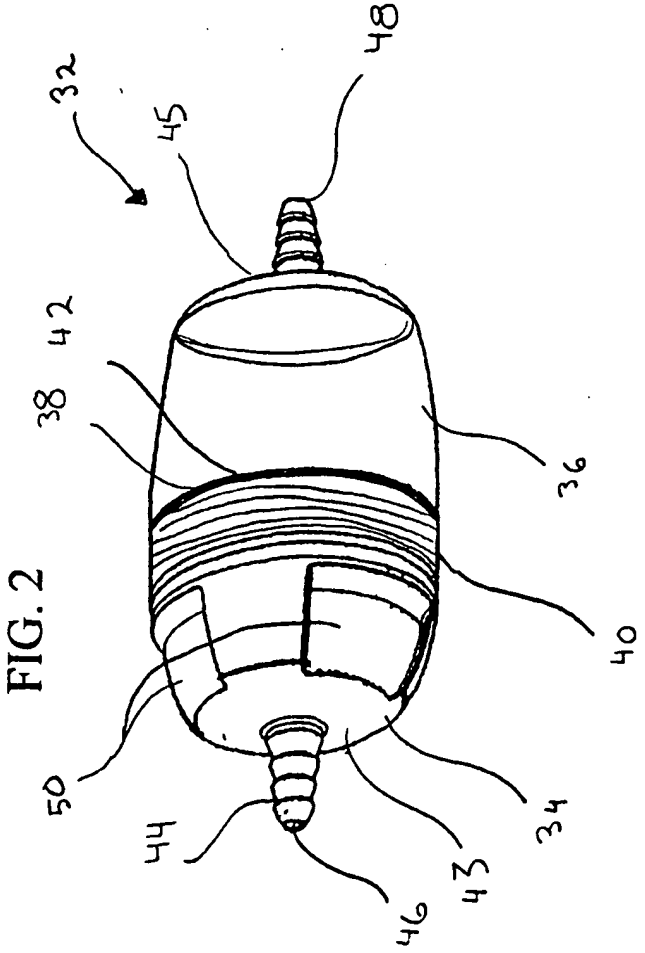

FIG. 2

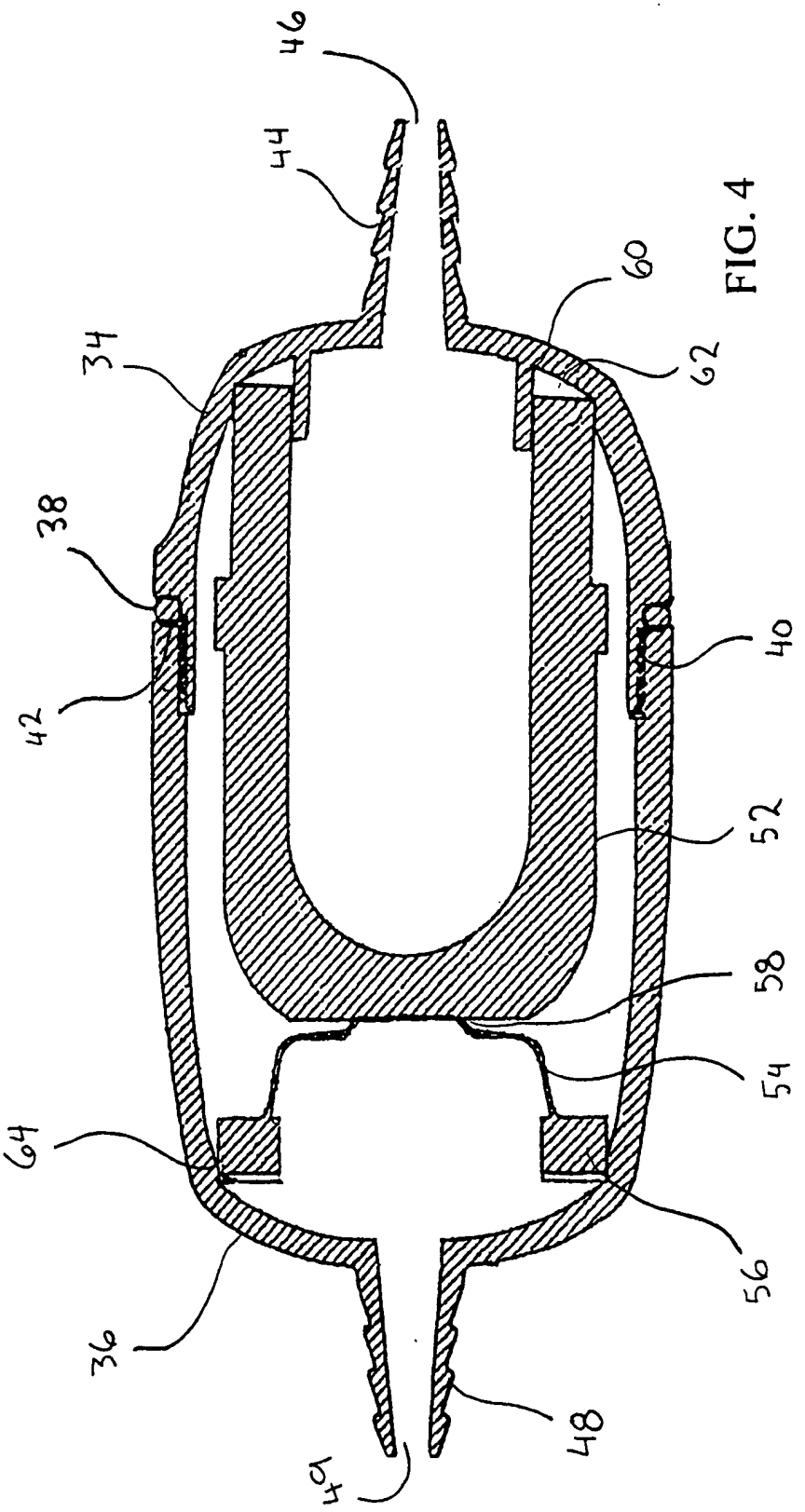

FIG. 4

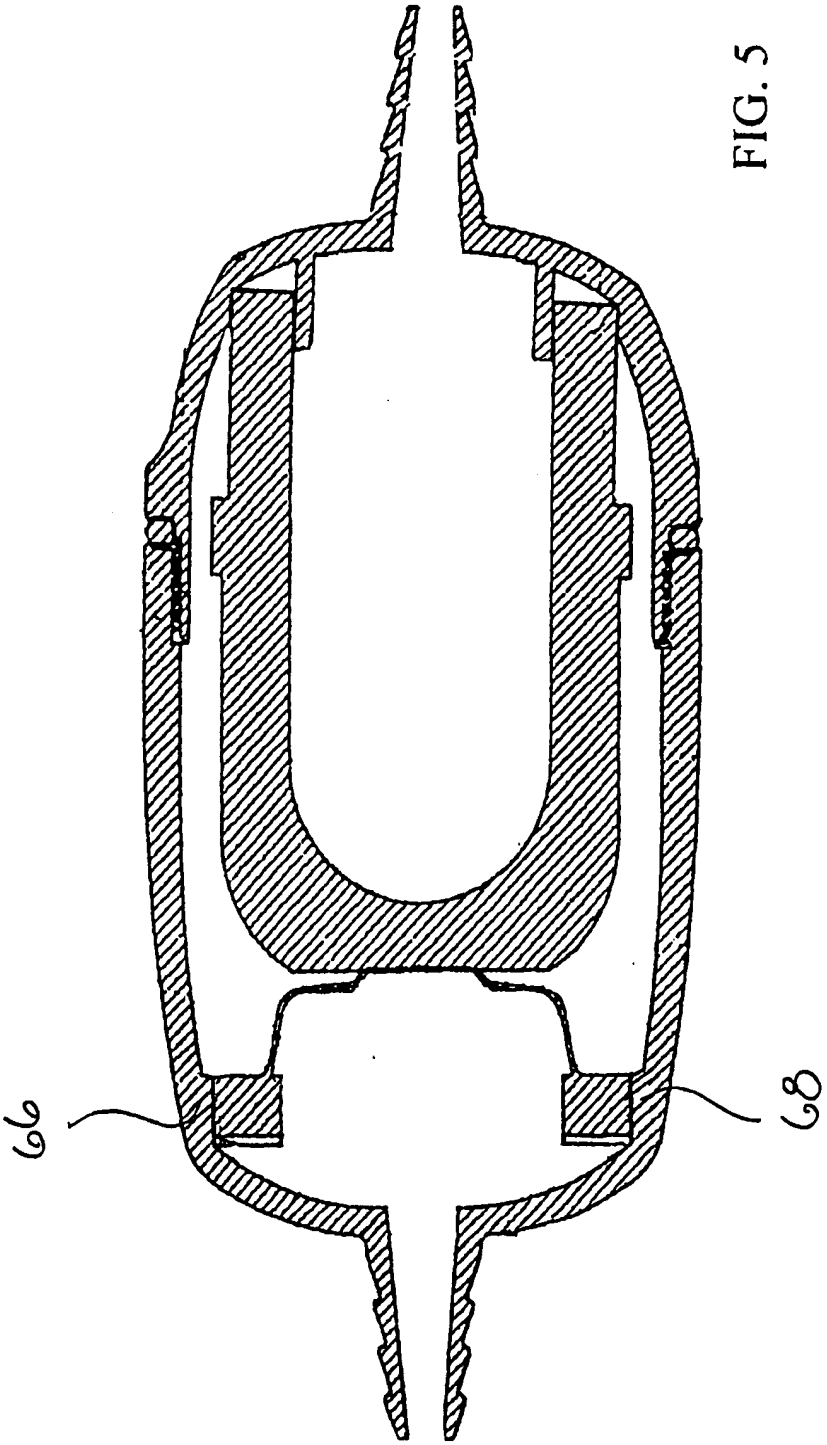

FIG. 5

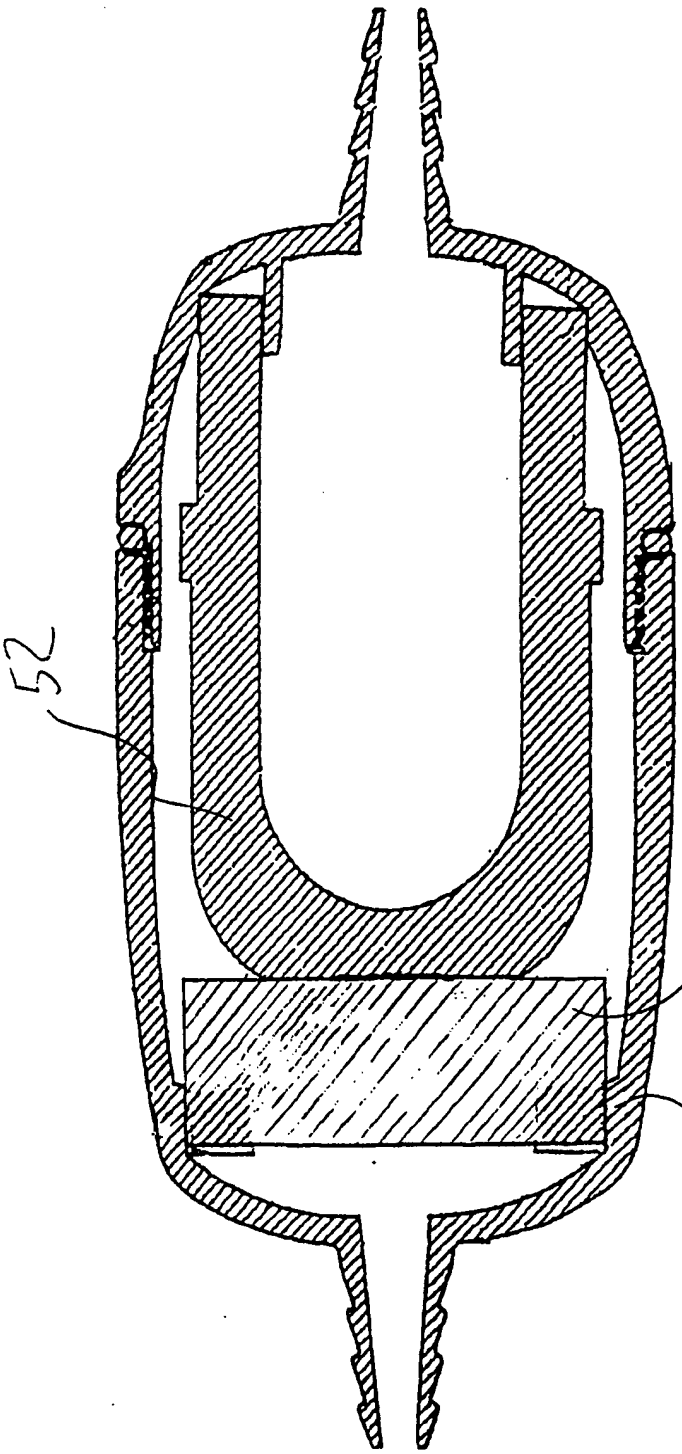

FIG. 6